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Smith

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(54) **MONOBORE WELLBORE AND METHOD FOR COMPLETING SAME**

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Related U.S. Application Data

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(51) **Int. Cl.**
E21B 17/00 (2006.01)

(52) **U.S. Cl.** **166/380**; 166/384; 166/50; 166/52

(58) **Field of Classification Search** 166/380, 166/207, 117.6, 117.5, 313, 245, 384, 50, 166/244.1, 52
See application file for complete search history.

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(57) **ABSTRACT**

A monobore wellbore (**68**) and method for completing the same are disclosed. The monobore wellbore (**68**) comprises a first casing (**74**) having an inner diameter (**76**) and a lap region (**80**). A second casing (**90**) is positioned within the wellbore (**70**) by passing through the first casing (**74**) such that an uphole end of the second casing (**90**) is positioned within the lap region (**80**) of the first casing (**74**). After downhole expansion, the second casing (**90**) has an inner diameter (**114**) that is substantially the same as the inner diameter (**76**) of the first casing. The uphole end of the second wellbore is coupled to the lap region (**80**) of the first casing (**74**) to create a mechanical connection and a hydraulic seal, thereby creating the monobore wellbore (**68**).

22 Claims, 13 Drawing Sheets

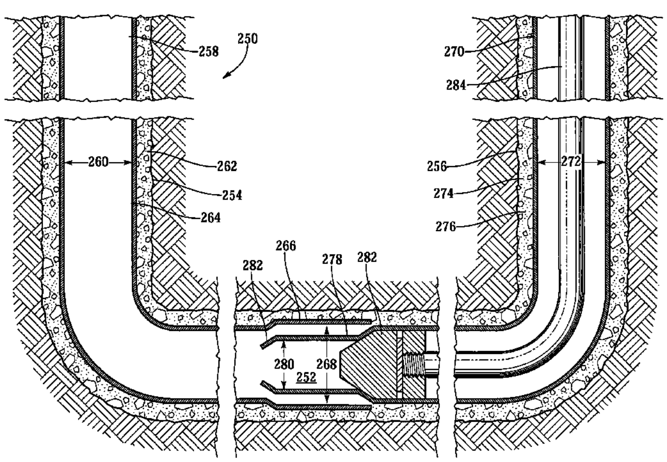

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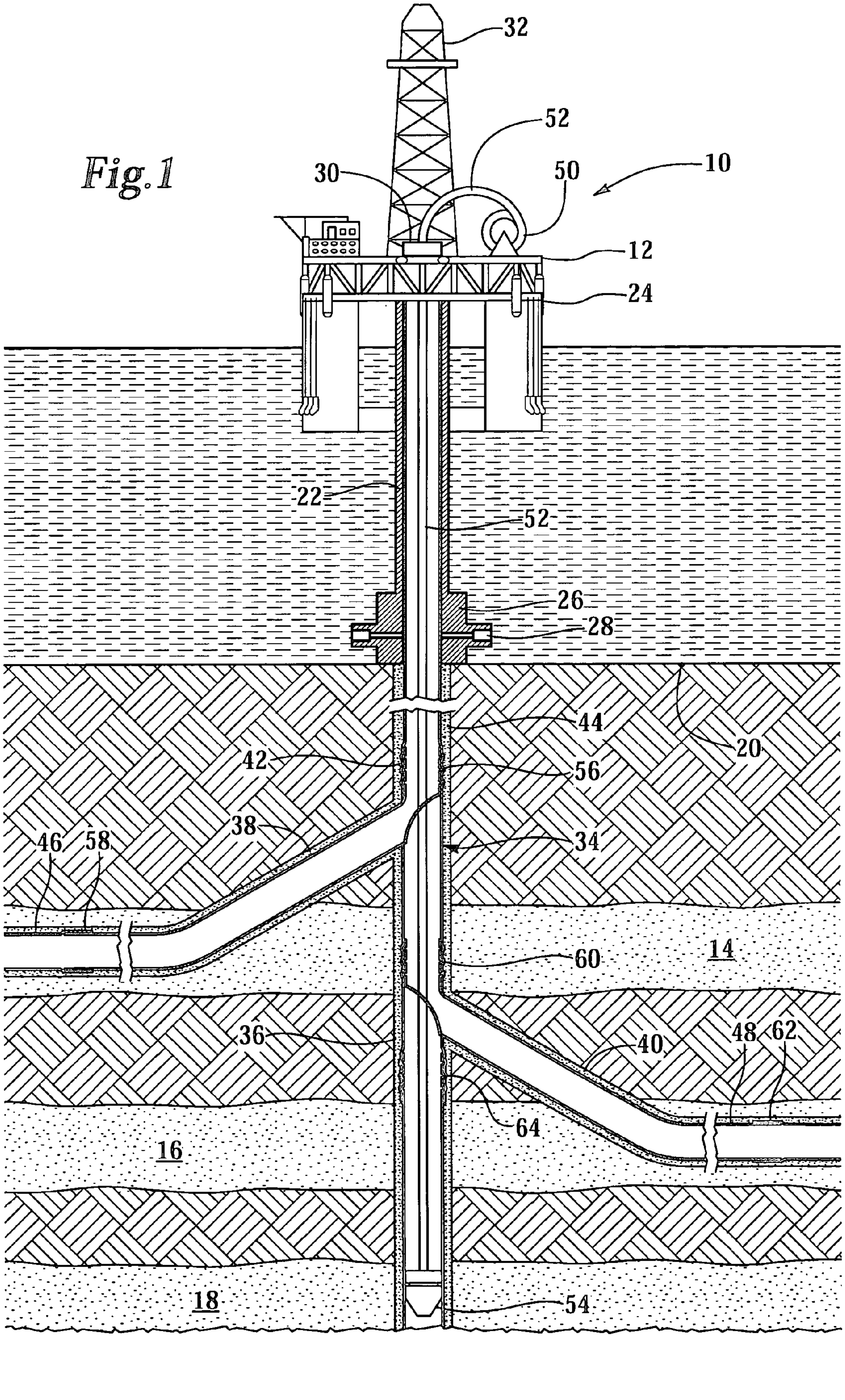
Fig.1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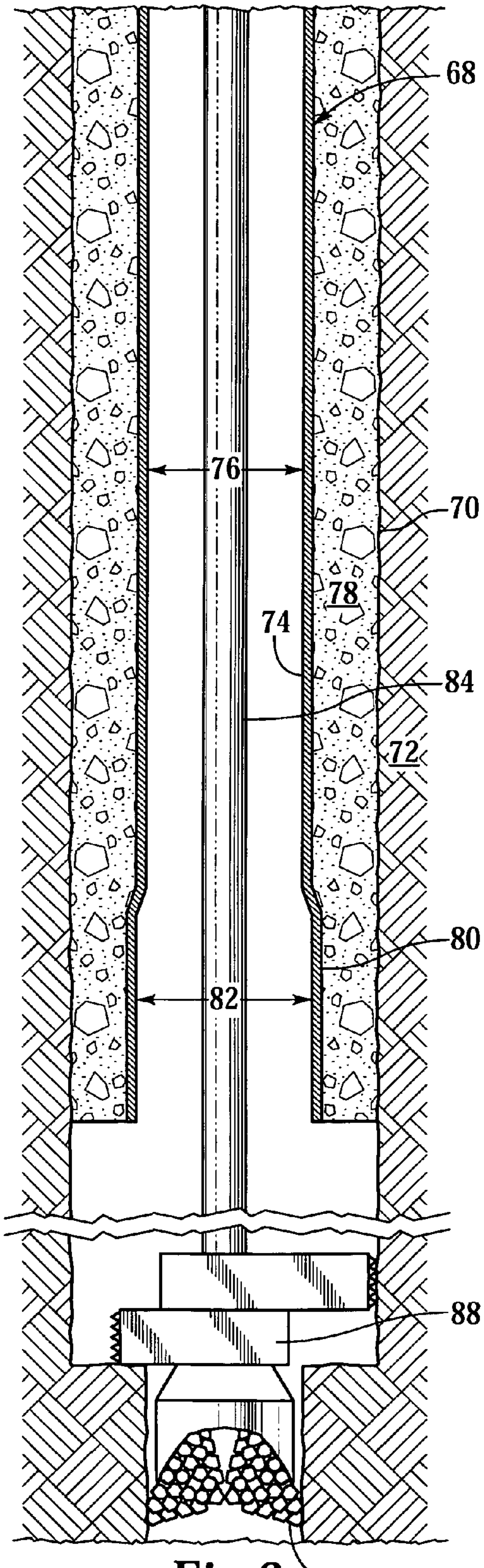

Fig.2

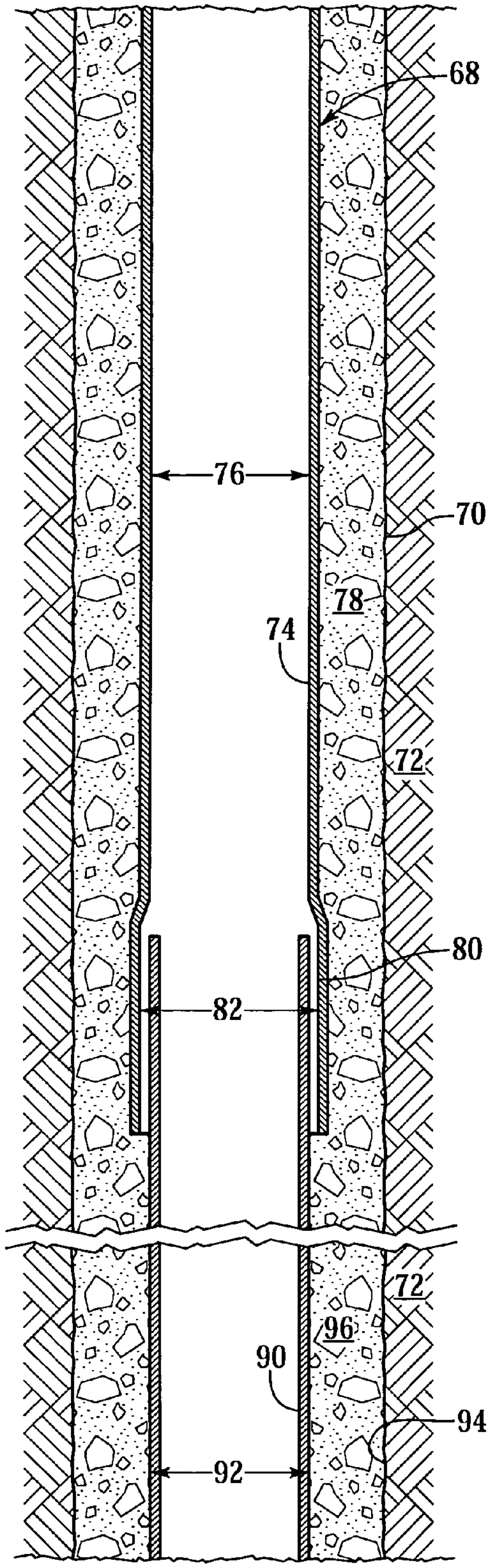

Fig.3

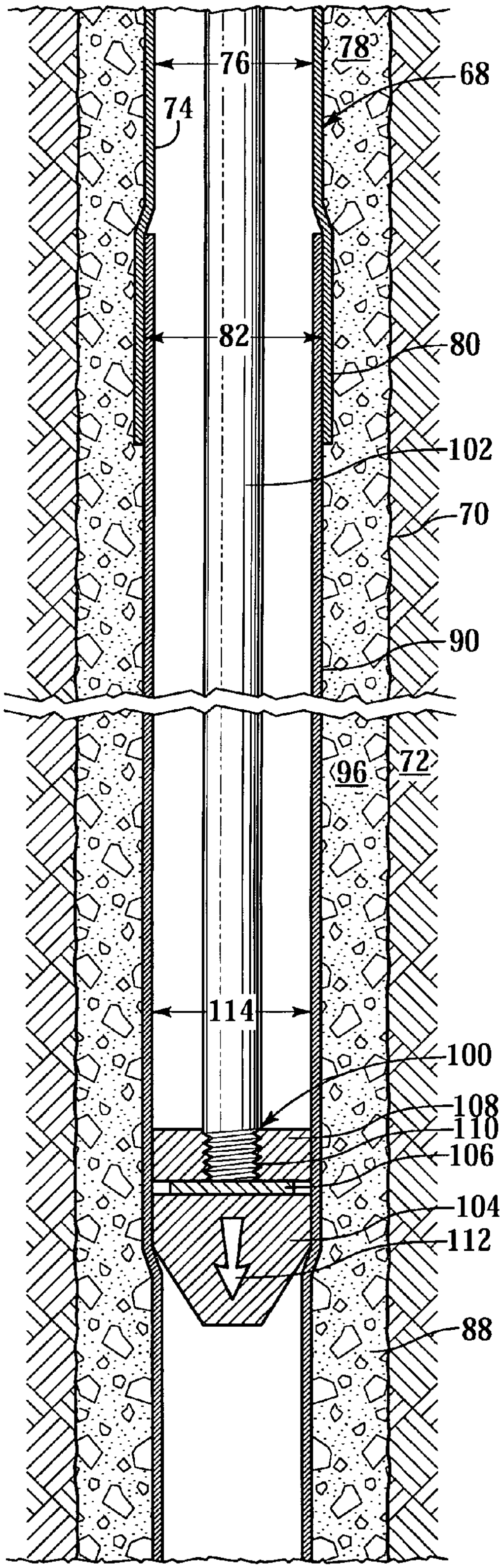
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Fig.4

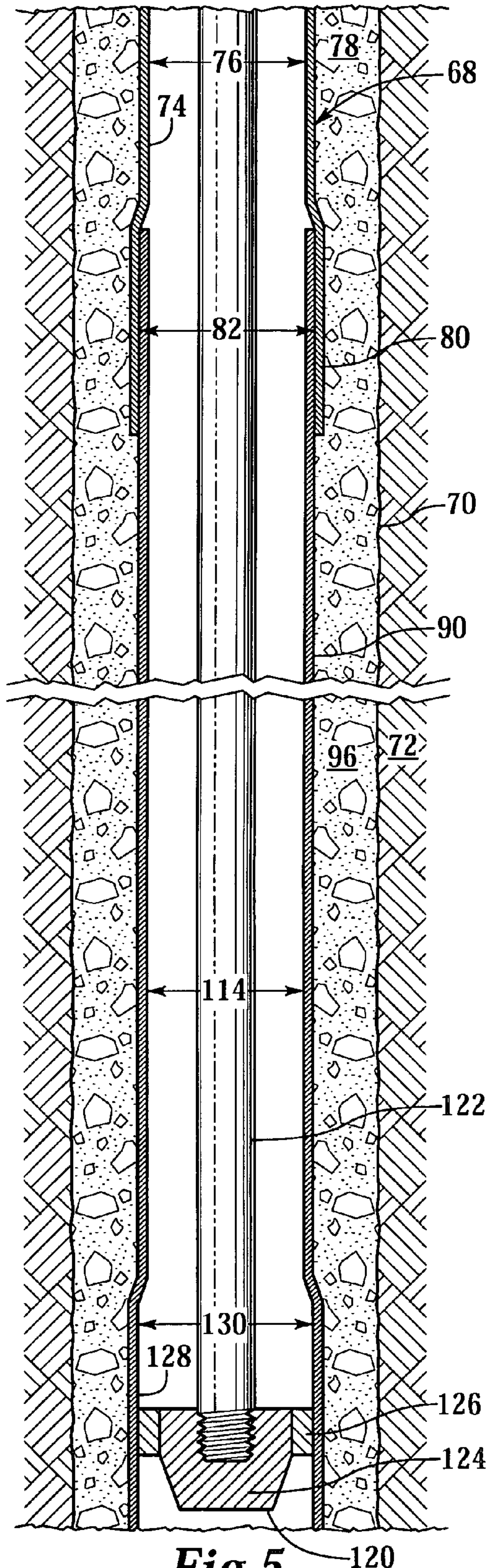
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Fig.5

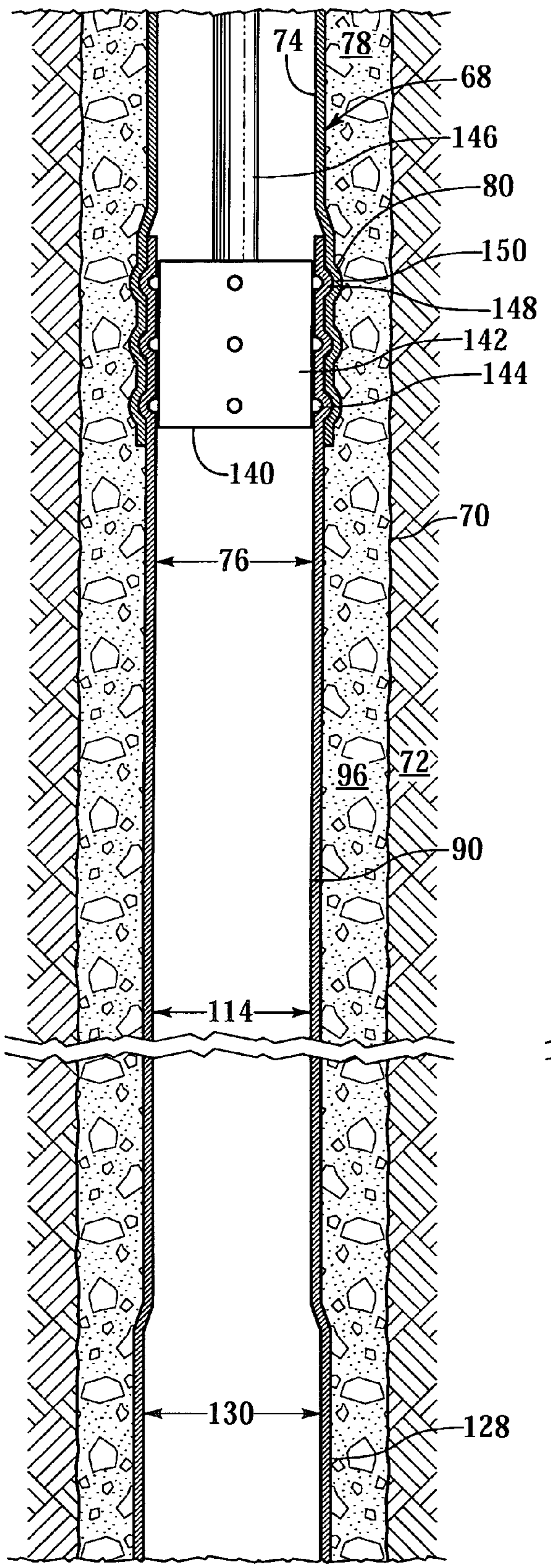
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Fig.6

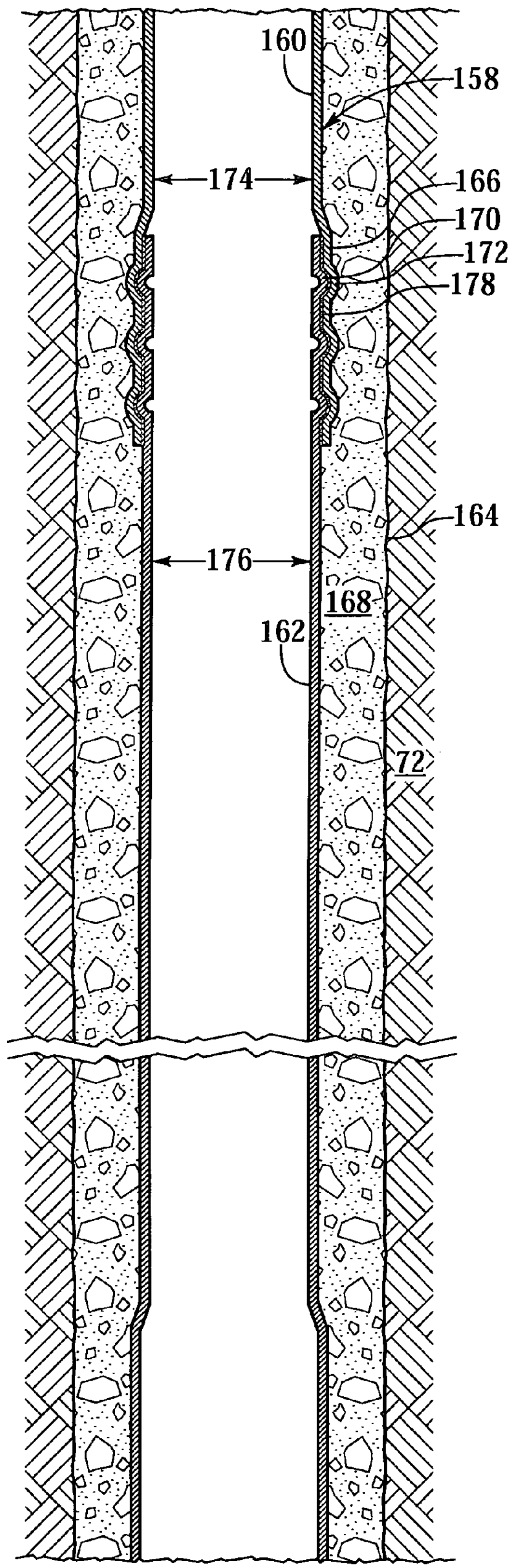
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Fig.7

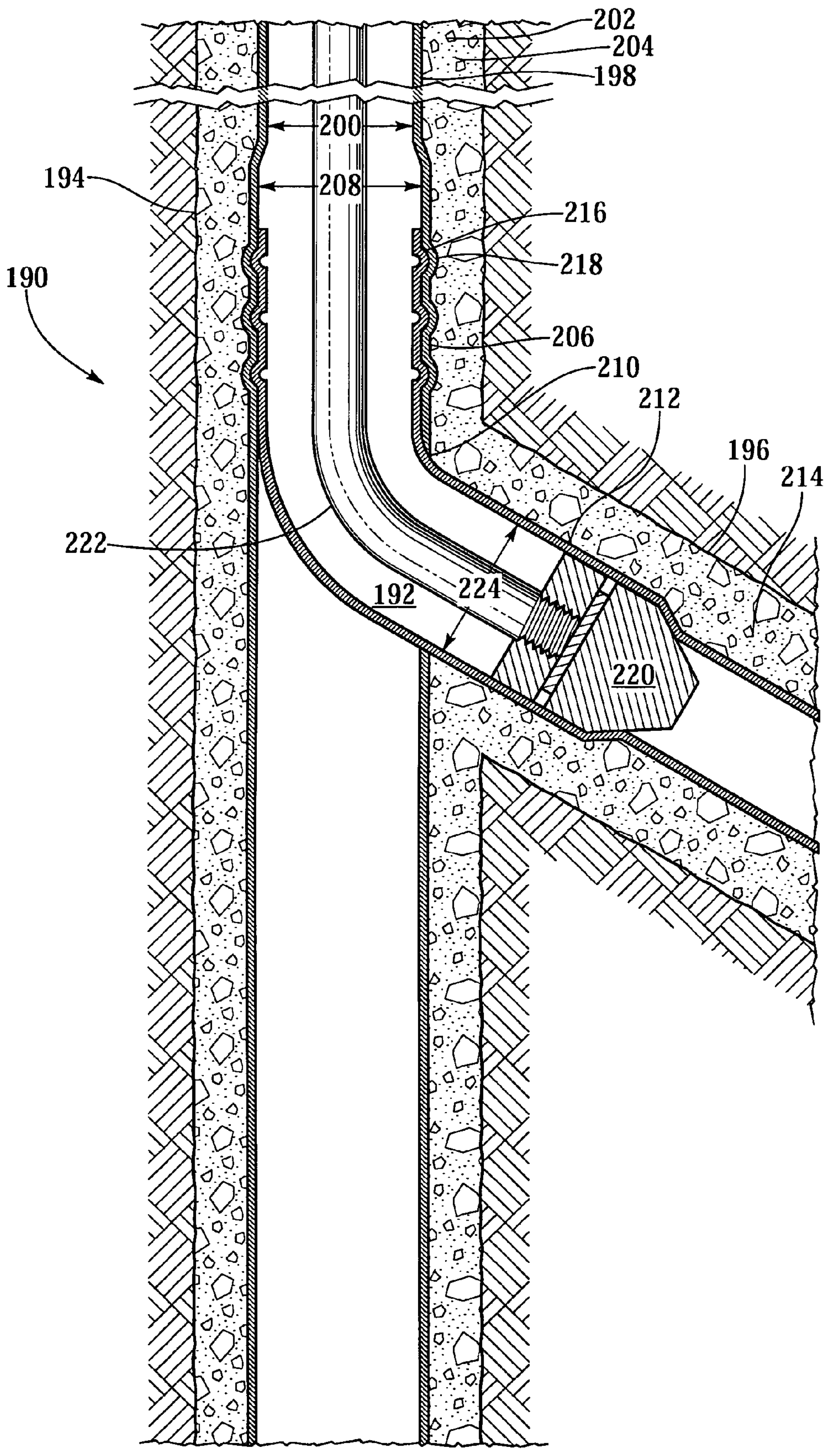
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Fig.8

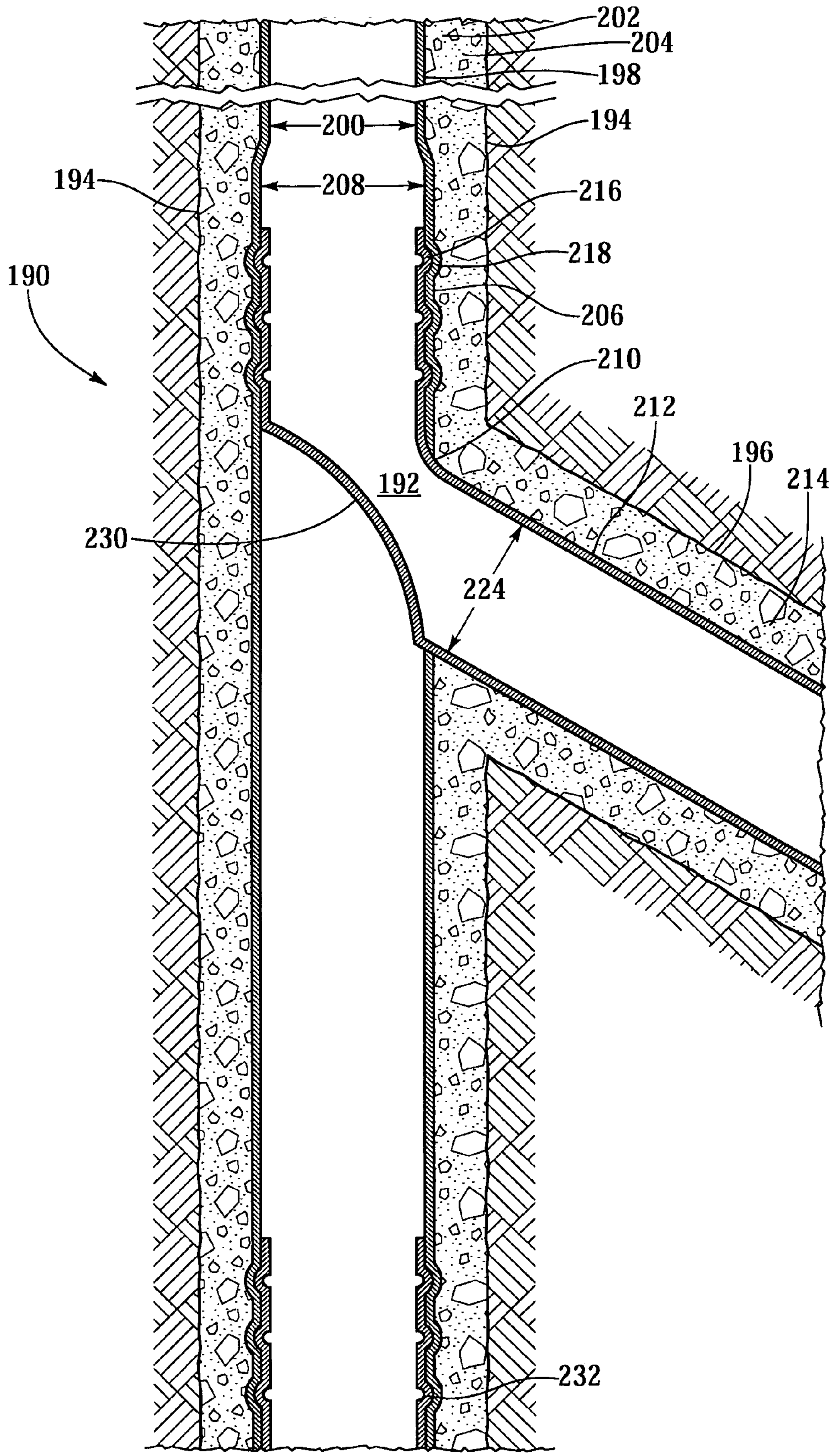
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Fig.9

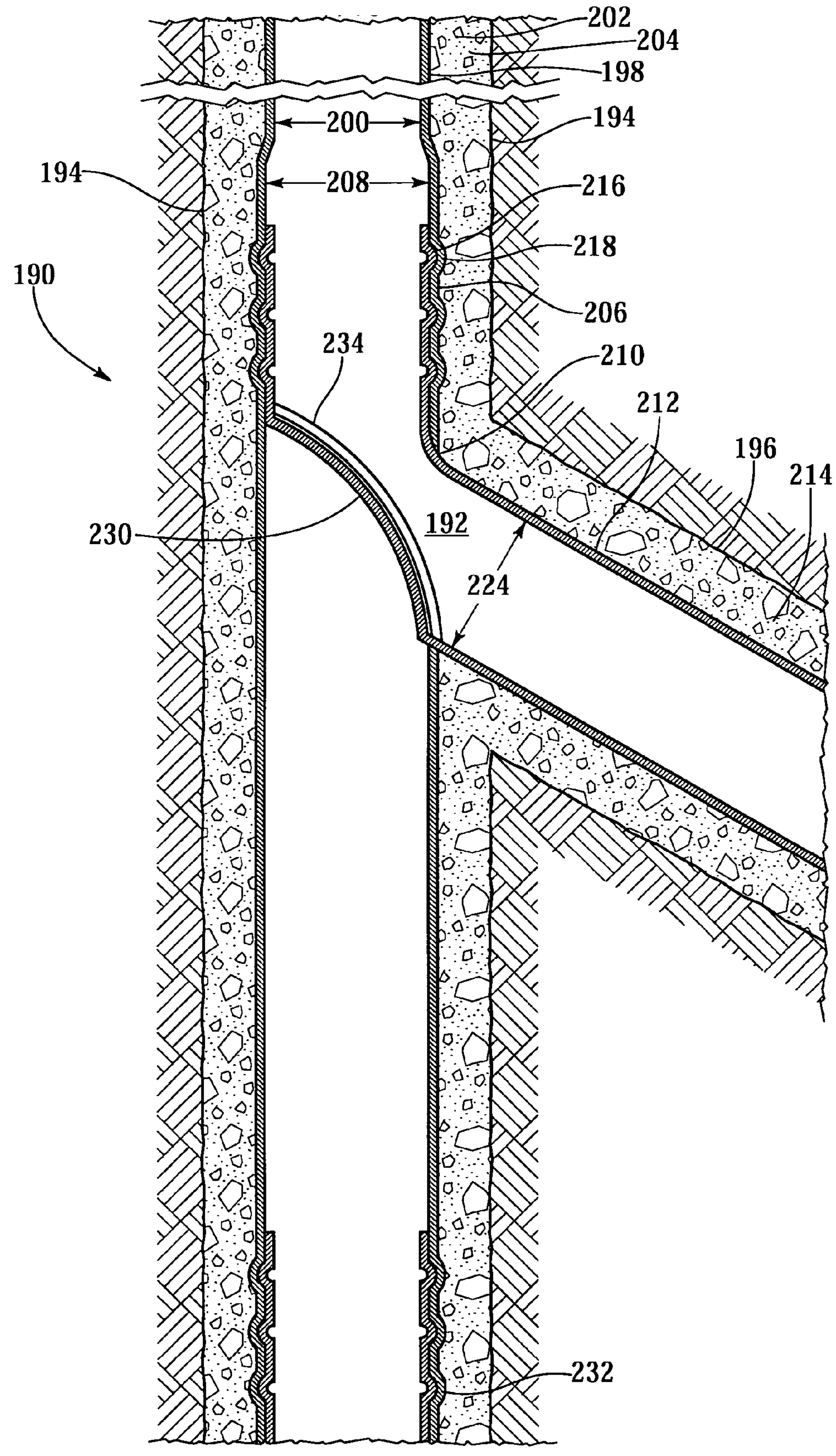
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Fig.10

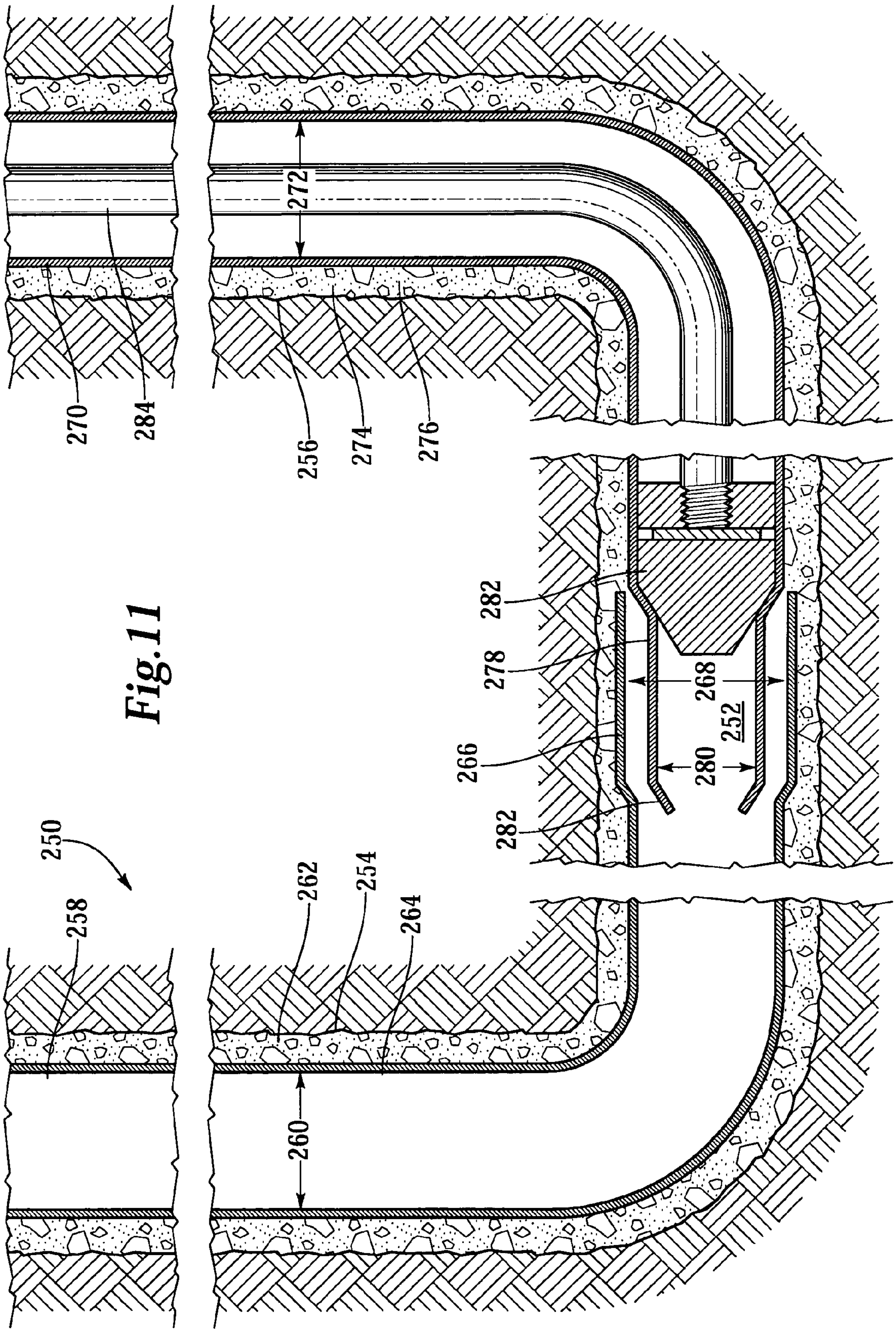

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Fig.11

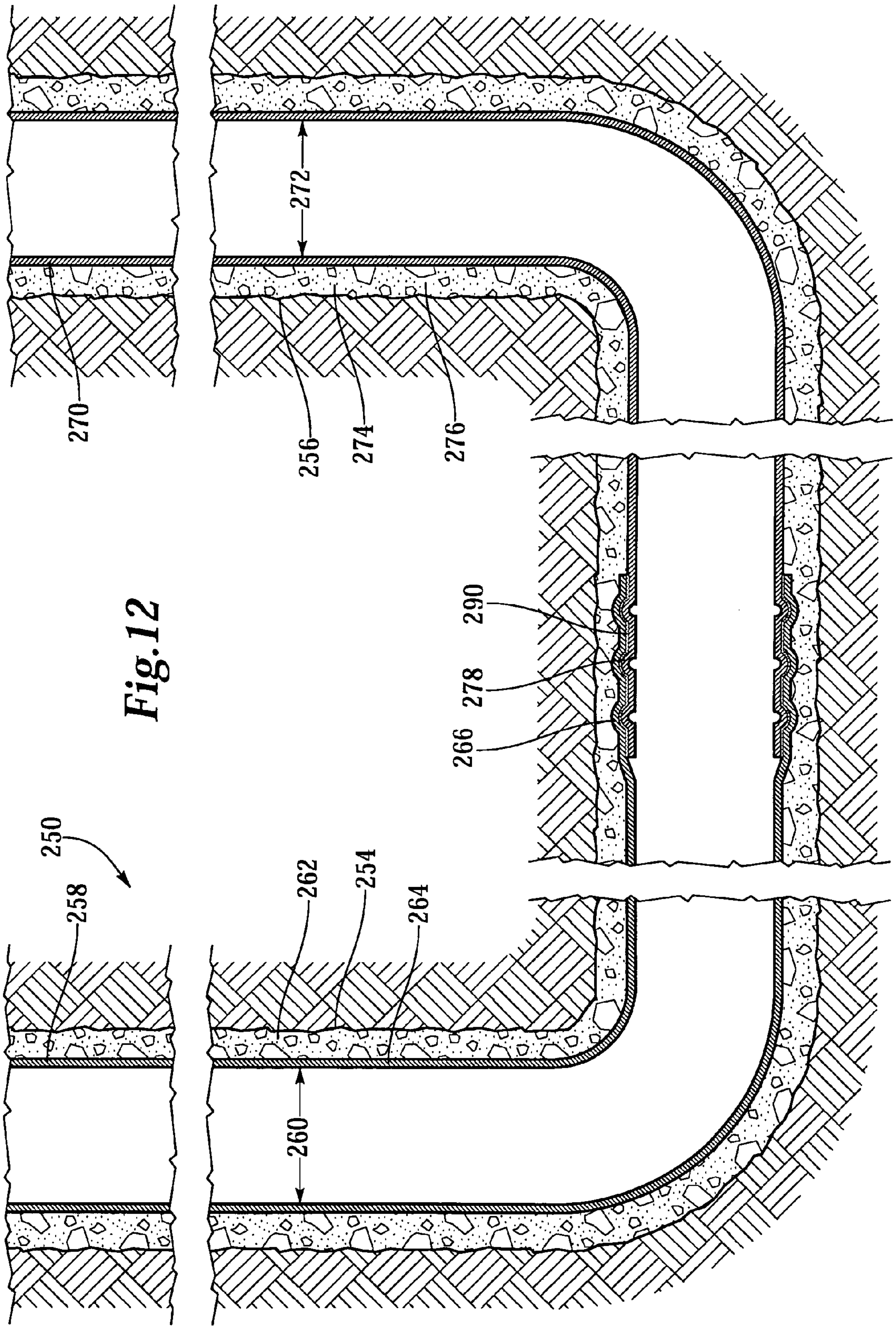

Fig.12

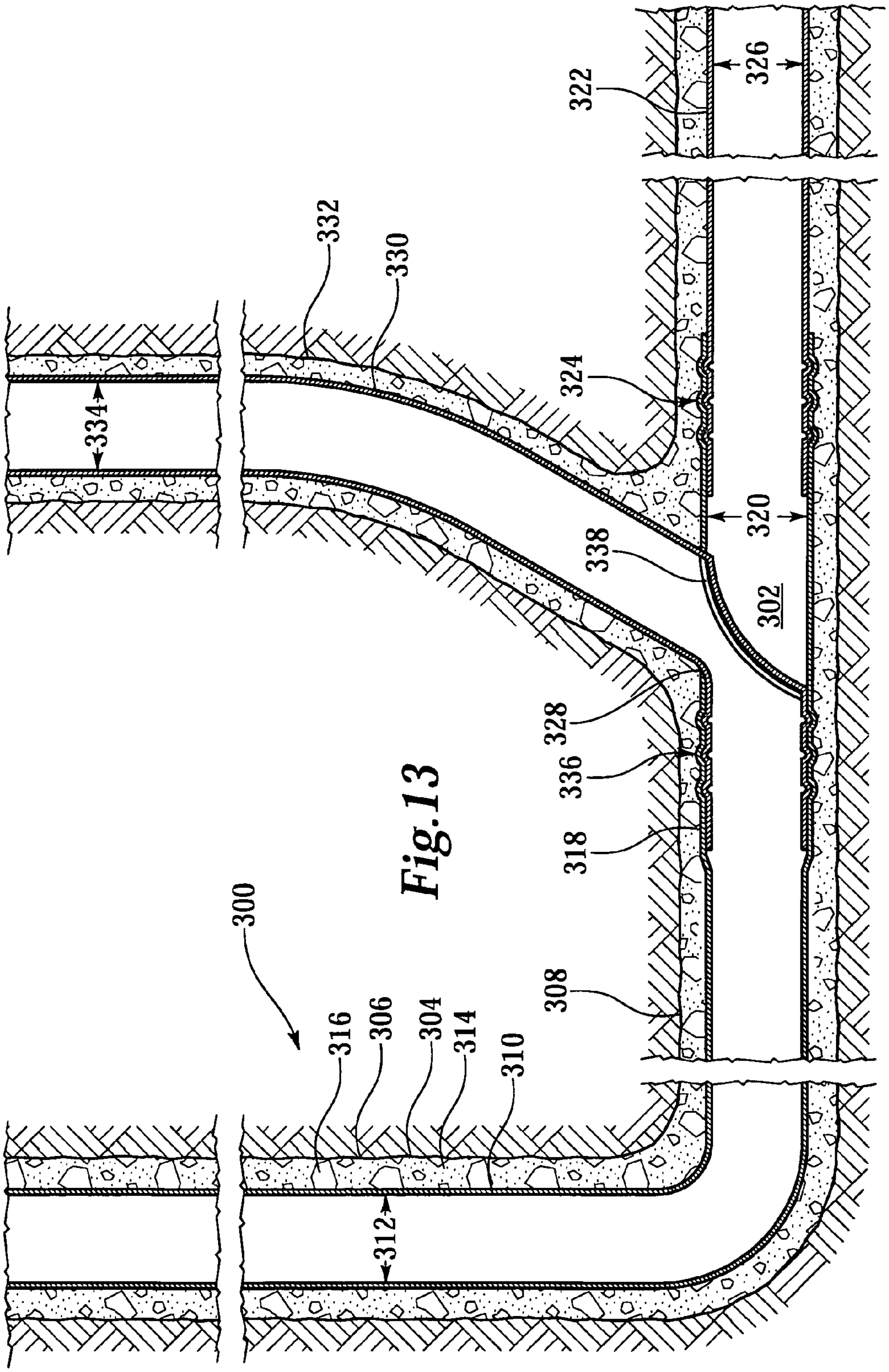
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Fig. 13

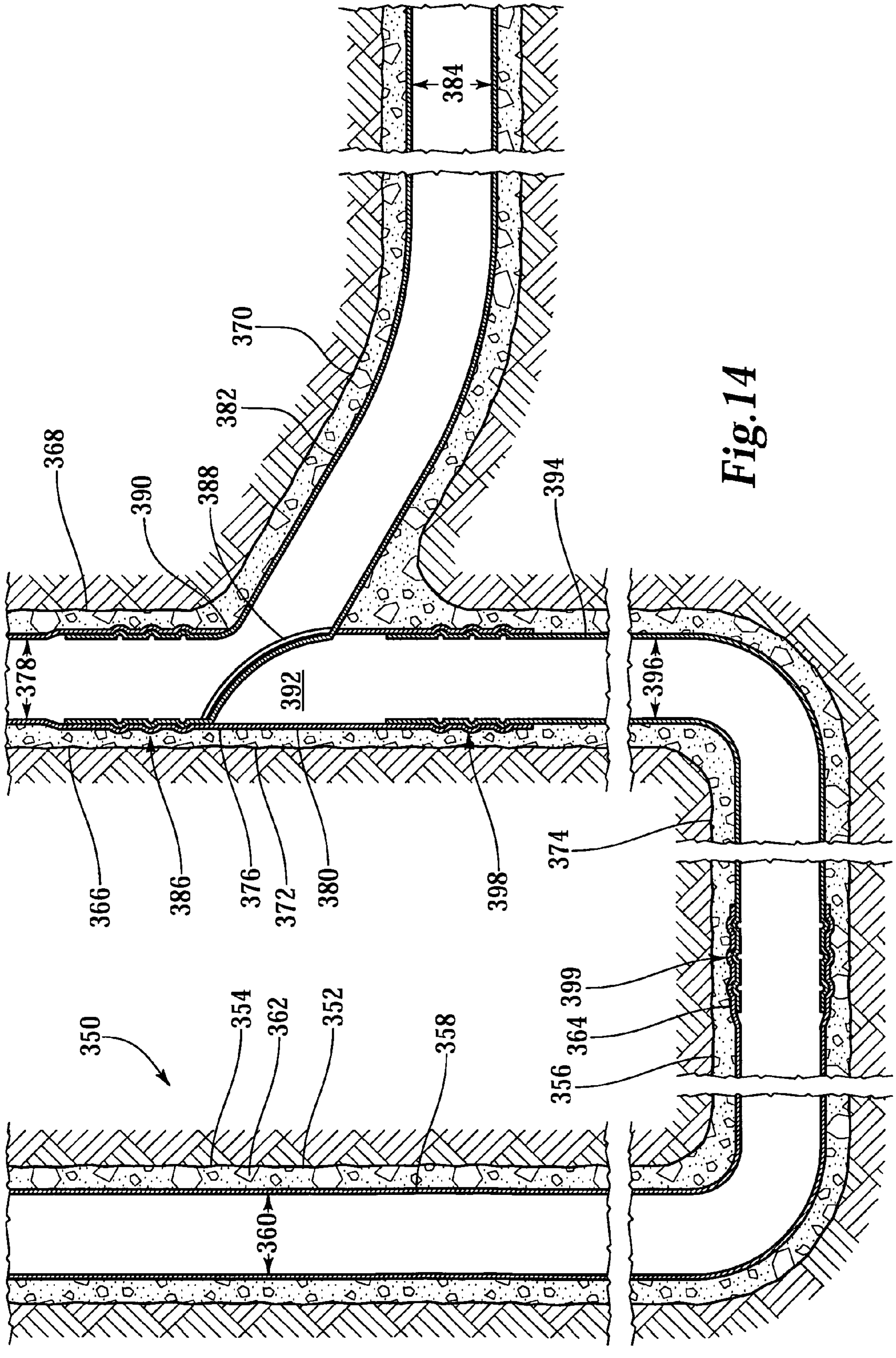
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Fig.14

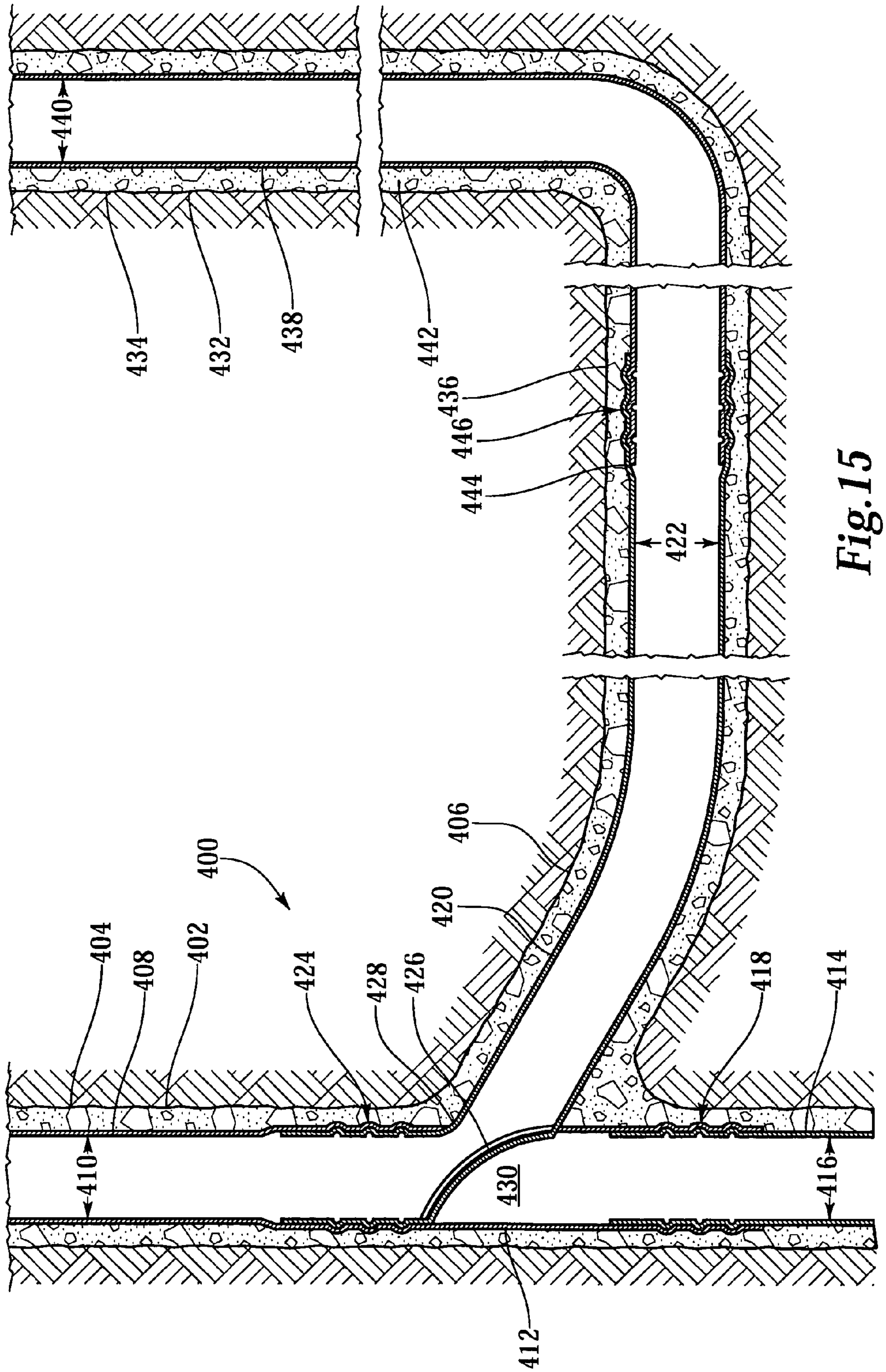
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Fig.15

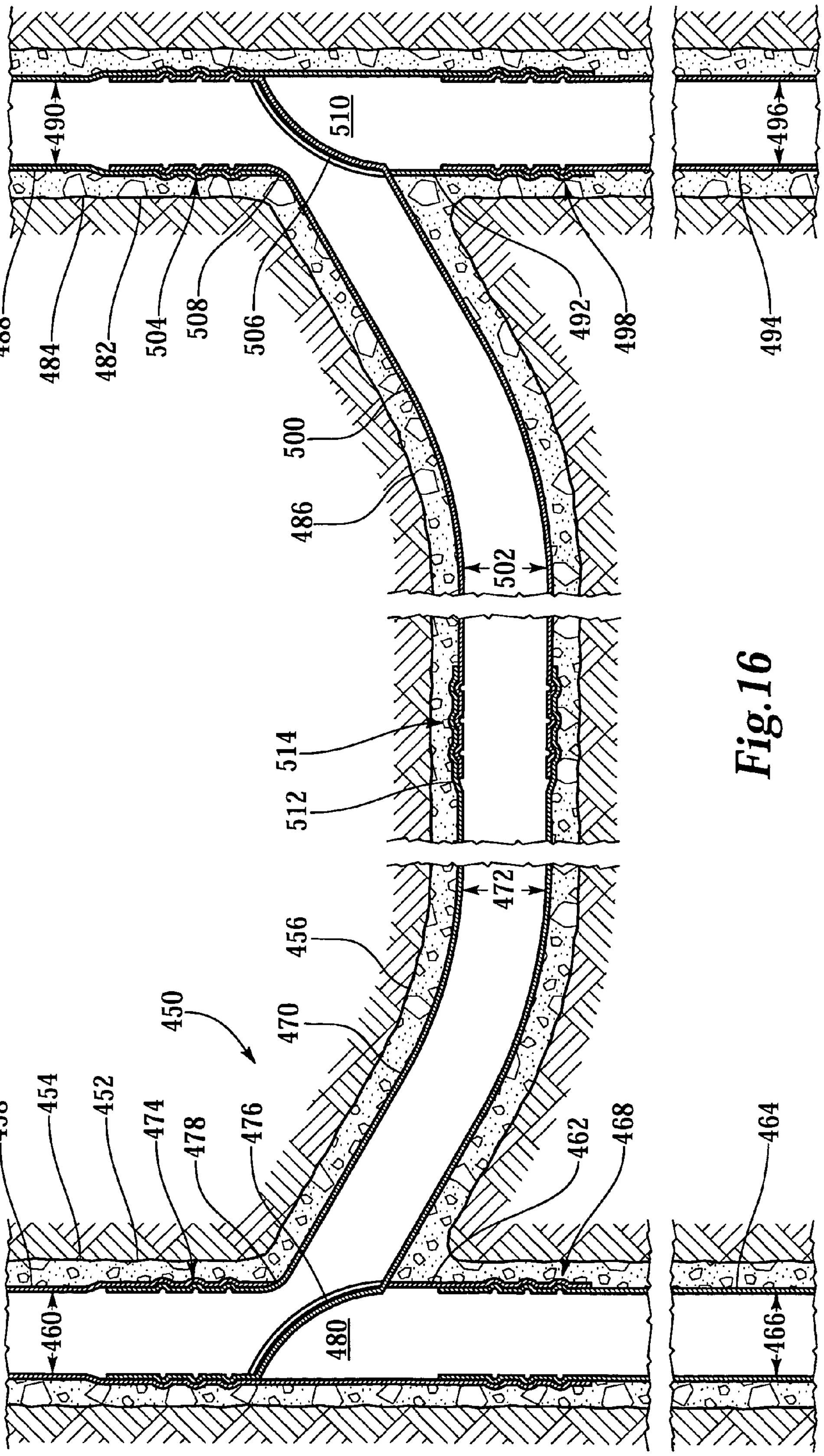
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Fig.16

MONOBORE WELLBORE AND METHOD FOR COMPLETING SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part application of application Ser. No. 10/103,381 now U.S. Pat. No. 6,749,026, entitled Downhole Tubular String Connection, filed on Mar. 21, 2002.

TECHNICAL FIELD OF THE INVENTION

This invention relates, in general, to completing a well that traverses a hydrocarbon bearing subterranean formation, and, in particular, to a monobore wellbore or multilateral monobore wellbore and method for completing the same by expanding and coupling portions of the casing downhole.

BACKGROUND OF THE INVENTION

Without limiting the scope of the present invention, its background will be described with reference to producing fluid from a subterranean formation, as an example.

After drilling each of the sections of a subterranean wellbore, individual lengths of relatively large diameter metal tubulars are typically secured together to form a casing string that is positioned within each section of the wellbore. This casing string is used to increase the integrity of the wellbore by preventing the wall of the hole from caving in. In addition, the casing string prevents movement of fluids from one formation to another formation.

Conventionally, each section of the casing string is cemented within the wellbore before the next section of the wellbore is drilled. Accordingly, each subsequent section of the wellbore must have a diameter that is less than the previous section. For example, a first section of the wellbore may receive a conductor casing string having a 20-inch diameter. The next several sections of the wellbore may receive intermediate casing strings having 16 -inch, 13⅜-inch and 9⅝-inch diameters, respectively. The final sections of the wellbore may receive production casing strings having 7-inch and 4½-inch diameters, respectively.

Each of the casing strings may be hung from a casinghead near the surface. The casinghead or spool is a heavy, flanged steel fitting connected to the first string of casing that provides a housing for slips and packing assemblies, allows suspension of intermediate and production strings of casing, and supplies the means for the annulus to be sealed off. Typically, a casing hanger provides the frictional gripping arrangement of slips and packing rings used to suspend casing from a casinghead in the well. Alternatively, some of the casing strings may be in the form of liner strings that extend from the setting depth up into another string of casing. Liners are typically suspended from the upper string by a hanger device such as a liner hanger that provides an arrangement of slips and packing rings.

It has been found, however, that each of these conventional casing techniques require multiple tubulars of decreasing diameters. Accordingly, production resources are not optimized and production is limited by the diameter of the smallest tubular. Moreover, the wellbore must be drilled to accommodate the larger tubulars and other downhole equipment such as blow-out preventers (BOPs) must be of an appropriate size to accommodate the larger tubulars.

Therefore a need has arisen for a system and method for casing a wellbore that optimizes resources while maintaining hydraulic and mechanical stability. A need has also arisen for such a system and method that minimizes the number of sizes of casing required to case the wellbore. In addition, a need has arisen for a system and method for casing a wellbore that minimizes the size requirements of equipment near the surface.

SUMMARY OF THE INVENTION

The present invention disclosed herein comprises a monobore wellbore and method for providing a monobore wellbore that are capable of optimizing available resources while maintaining hydraulic and mechanical stability. The monobore wellbore and method of the present invention require a minimum number of sizes of casing and minimize the size of equipment near the surface. The monobore wellbore of the present invention achieves these results by expanding and coupling casing strings together to create a monobore with substantially one inner diameter.

The monobore wellbore of the present invention comprises a first casing having a first inner diameter that is positioned within a wellbore. The first casing has a lap region in a downhole end thereof. A second casing is passed through the first casing and is positioned within the wellbore such that an uphole end of the second casing is positioned within the lap region of the first casing. Once expanded downhole, the second casing has an inner diameter substantially the same as the first inner diameter. The uphole end of the second casing is coupled to the lap region of the first casing. In one embodiment, the second casing is positioned within a branch wellbore of a main wellbore to form a monobore multilateral wellbore.

The coupling of the second casing to the first casing results in a mechanical connection and a hydraulic seal therebetween. In one embodiment, the uphole end of the second casing and the lap region of the first casing are physically deformed together by a crimping process. The physical deformation may be the result of a plastic deformation process. In another embodiment, the uphole end of the second casing forms a metal-to-metal seal with the lap region of the first casing. Alternatively, a sealing material such as an elastomeric sealant may be positioned between the uphole end of the second casing and the lap region of the first casing. In one embodiment, the lap region of the first casing has a diameter that is larger than the first inner diameter. This larger diameter may be formed while the first casing is downhole.

To further extend the monobore wellbore, a third casing is passed through the first and second casings and is positioned within the wellbore such that an uphole end of the third casing is positioned within a second lap region of the second casing. Once expanded downhole, the third casing has an inner diameter substantially the same as the inner diameter of the second casing. The uphole end of the third casing is coupled to the second lap region of the second casing, thereby creating a monobore wellbore.

In a further aspect, the present invention is directed to a monobore wellbore formed between two adjoining wellbores each of which extend to the surface. A first casing is positioned within a first wellbore that includes a first inner diameter and a lap region. A second casing is positioned within a second wellbore that intersects the first wellbore such that a downhole end of the second casing is positioned within the lap region of the first casing. The second casing is then expanded to an inner diameter that is substantially the same as the first inner diameter. The downhole end of the second casing is coupled to the lap region of the first casing, thereby creating a monobore wellbore of adjoining wellbores. In one embodiment, one or more of the adjoining wellbores are multilateral wellbores wherein the adjoining portions of the wellbores may be main wellbores, branch wellbores or combinations thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the features and advantages of the present invention, reference is now made to the detailed description of the invention along with the accompanying figures in which corresponding numerals in the different figures refer to corresponding parts and in which:

FIG. **1** is a schematic illustration of an offshore oil and gas platform installing a multilateral monobore wellbore of the present invention;

FIG. **2** is a half sectional view of a monobore wellbore according to the present invention wherein the wellbore is being extended;

FIG. **3** is a half sectional view of a monobore wellbore according to the present invention wherein a second wellbore casing is positioned in the wellbore downhole of a first wellbore casing;

FIG. **4** is a half sectional view of a monobore wellbore according to the present invention wherein the second wellbore casing is being expanded;

FIG. **5** is a half sectional view of a monobore wellbore according to the present invention wherein the downhole end of the second wellbore casing is undergoing a second expansion;

FIG. **6** is a half sectional view of a monobore wellbore according to the present invention wherein the uphole end of the second wellbore casing is coupled to a lap region of the first wellbore casing;

FIG. **7** is a half sectional view of a monobore wellbore according to the present invention wherein a sealing material is positioned between the overlapping regions of the first wellbore casing and the second wellbore casing;

FIG. **8** is a half sectional view of a multilateral monobore wellbore according to the present invention wherein a lateral wellbore casing is being expanded;

FIG. **9** is a half sectional view of a multilateral monobore wellbore according to the present invention wherein an opening has been cut through a lateral wellbore casing;

FIG. **10** is a half sectional view of a multilateral monobore wellbore according to the present invention wherein the lateral wellbore casing is coupled to the main wellbore casing around the opening;

FIG. **11** is a half sectional view of a monobore wellbore formed according to the present invention between two adjoining wellbores;

FIG. **12** is a half sectional view of a monobore wellbore according to the present invention wherein the casings within the two adjoining wellbores are coupled together;

FIG. **13** is a half sectional view of a monobore wellbore according to the present invention wherein the casings of two adjoining wellbores are coupled together at a junction;

FIG. **14** is a half sectional view of a monobore wellbore according to the present invention wherein the casings of two adjoining main wellbores are coupled together;

FIG. **15** is a half sectional view of a monobore wellbore according to the present invention wherein a branch wellbore casings is connected to an adjoining main wellbore casing; and

FIG. **16** is a half sectional view of a monobore wellbore according to the present invention wherein the casings of two adjoining branch wellbores are coupled together.

DETAILED DESCRIPTION OF THE INVENTION

While the making and using of various embodiments of the present invention are discussed in detail below, it should be appreciated that the present invention provides many applicable inventive concepts which can be embodied in a wide variety of specific contexts. The specific embodiments discussed herein are merely illustrative of specific ways to make and use the invention, and do not delimit the scope of the present invention.

The present invention provides improved methods and apparatuses for creating a monobore wellbore. The methods can be performed in either vertical or horizontal wellbores. The term "vertical wellbore" is used herein to mean the portion of a wellbore in a producing zone to be completed which is substantially vertical, inclined or deviated. The term "horizontal wellbore" is used herein to mean the portion of a wellbore in a subterranean producing zone, which is substantially horizontal. Since the present invention is applicable in vertical, horizontal and inclined wellbores, the terms "upper and lower," "top and bottom," as used herein are relative terms and are intended to apply to the respective positions within a particular wellbore while the term "levels" is meant to refer to respective spaced positions along the wellbore. The term "zone" is used herein to refer to separate parts of the well designated for treatment and production and includes an entire hydrocarbon formation or even separate portions of the same formation and horizontally and vertically spaced portions of the same formation. As used herein, "down," "downward" or "downhole" refer to the direction in or along the wellbore from the wellhead toward the producing zone regardless of whether the wellbore's orientation is horizontal, toward the surface or away from the surface. Accordingly, the upper zone would be the first zone encountered by the wellbore and the lower zone would be located further along the wellbore. Tubing, tubular, casing, pipe liner and conduit are interchangeable terms used herein to refer to walled fluid conductors.

Referring initially to FIG. **1**, a multilateral monobore wellbore of the present invention is being installed from an offshore oil and gas platform that is schematically illustrated and generally designated **10**. A semi-submersible platform **12** is centered over submerged oil and gas formations **14**, **16**, **18** located below sea floor **20**. A subsea conduit **22** extends from deck **24** of platform **12** to wellhead installation **26** including subsea BOPs **28**. Platform **12** has a hoisting apparatus **30** and a derrick **32** for raising and lowering pipe strings.

A monobore multilateral wellbore **34** having a main wellbore **36** and branches **38**, **40** extends through the various earth strata including formations **14**, **16**, **18**. A main wellbore casing **42** is cemented within wellbore **36** by cement **44**. A branch wellbore casing **46** is positioned within branch wellbore **38** and a branch wellbore casing **48** is positioned within branch wellbore **40**. A reel **50** located at platform **12** raises and lowers coiled tubing **52**. Coiled tubing **52** is coupled on its lower end to an expander member **54** that is positioned at the far end of main wellbore **36** after expanding the portion of the main wellbore **36** downhole of branch wellbore **40**.

As explained in greater detail below, after positioning a section of casing in the wellbore such that the uphole end of the section of casing is positioned within the lap region of an existing section of casing, the new section of casing is expanded to a diameter substantially the same as the diameter of the existing section of casing by expander member **54**. Additionally, a hydraulic seal and mechanical connection are created between the two casings either before or after the expansion process by expansion of the uphole end of the new section of the casing into the lap region of the existing section of casing. The system and method for creating a monobore wellbore creates regions of overlapping casings, such as overlaps **56**, **58**, **60**, **62** and **64**.

Referring now to FIG. **2**, therein is depicted a monobore wellbore **68** wherein a more detailed view of one method for drilling is illustrated in accordance with the teachings of the present invention. A wellbore **70** extends through various earth strata **72**. A casing **74** having an inner diameter **76** is cemented within wellbore **70** by cement **78**. A lap region **80** having an inner diameter **82** provides an interval in casing **74** wherein the uphole portion of an installed casing (not shown) may overlap the downhole portion of casing **74** which allows for the installation of a monobore wellbore of the present invention. Preferably, the downhole portion of casing **74** comprises an expandable material that may be expanded to form lap region **80** as described in more detail below. Alternatively, casing **74** may be prefabricated with lap region **80**. As another alternative, lap region **80** may initially have the same inner diameter as the rest of casing **74** and may be expanded at the same time as the upper portion of the section of casing that is installed downhole of casing **74** and overlaps lap region **80**.

After passing through casing **74**, a drill string **84** transmits fluid and rotational power to a drill bit **86** to extend wellbore **70**. In order to be operable, drill bit **86** must be proportioned to fit through diameter **76** of casing **74**. Additionally, in order to facilitate the drilling of relatively large bores below the existing cased wellbore **70**, drill bit **86** may be used in conjunction with an underreamer **88** or other device to enlarge wellbore **70** below casing **74** to a hole size larger than inner diameter **76** of casing **74**. It should be apparent to one skilled in the art that although a specific drill bit assembly is illustrated and described, the drill bit may include any cutting or boring element known in the art.

Referring now to FIG. **3**, therein is depicted monobore wellbore **68** wherein casing **74** is installed in accordance with the teachings of the present invention. Following drilling to a desired depth and retrieving drill string **84**, casing **90** is passed through casing **74** and is positioned within wellbore **70** such that the uphole end of casing **90** is positioned within lap region **80** of casing **74**. Casing **90** has an outer diameter **92** that is smaller than inner diameter **76** of casing **74** such that casing **90** may be lowered through casing **74**. As will be discussed in more detail below, casing **90** is radially expandable upon the application of a radially applied force. Casing **90** is preferably expandable and made from steel, steel alloys or other expandable materials. More specifically, casing **90** is preferably radially expandable to have an inner diameter that is substantially the same as inner diameter **76** of casing **74**. In addition, the uphole end of casing **90** is coupled to lap region **80** of casing **74** by expanding the uphole end of casing **90** such that the outer diameter of casing **90** is greater than inner diameter **82** of lap region **80** of casing **74**. Importantly, each lap region has a diameter large enough to accommodate the uphole portion of the next casing such that a monobore is formed. After casing **90** is positioned within wellbore **70** but prior to expansion and coupling, annulus **94** between wellbore **70** and casing **90** may be cemented by cement **96** using conventional methods such as by the deployment of a cementing tool to inject a prescribed quantity of cement **96** into annulus **94** between casing **90** and wellbore **70**.

Referring now to FIG. **4**, therein is depicted monobore wellbore **68** wherein newly installed casing **90** is being expanded in accordance with the present invention. Following the installation of casing **90**, an expander member **100** attached to coiled tubing **102** is positioned at the uphole end of casing **90**. Expander member **100** includes a tapered cone section **104**, a piston **106** and an anchor section **108**. Anchor section **108** includes a receiver portion **110** that is coupled to the lower end of coiled tubing string **102**.

In operation, a downward force is applied on expander member **100** by applying the weight of coiled tubing **102** on expander member **100**. This downward force operates to stroke piston **106** to its compressed position. Once piston **106** completes its downward stroke, fluid is pumped down coiled tubing string **102** which sets anchor section **108** creating a friction grip between anchor section **108** and casing **90** which prevents upward movement of anchor section **108**. As more fluid is pumped down coiled tubing string **102** into the interior of expander member **100**, as indicated by arrow **112**, the fluid pressure urges tapered cone section **104** downwardly such that tapered cone section **104** places a radially outward force against the wall of expandable casing **90** causing casing **90** to radially plastically deform. This process continues in step wise fashion wherein each stroke of expander member **100** expands a section of expandable casing **90**. After the desired length of expandable casing **90** has been expanded, coiled tubing string **102** and expander member **100** may be retrieved to the surface. It should be understood by those skilled in the art that although the expansion of expandable casing **90** has been illustrated as progressing from an uphole position to a downhole position, the expansion could alternatively progress from a downhole location to an uphole location.

Casing **90** is expanded such that the inner diameter **114** of casing **90** is substantially the same as inner diameter **76** of casing **74**, thereby providing a monobore wellbore. A wellbore of this construction employs only one size of casing and requires drilling only one hole size. Accordingly, the drilling is less complex and more economical. Similarly, the size of the downhole equipment near the surface, such as BOPs, is reduced.

Referring now to FIG. **5**, therein is depicted monobore wellbore **68** wherein casing **90** is undergoing a second expansion at the downhole end in accordance with the teachings of the present invention. More specifically, following the installation, cementing and first expansion of casing **90**, a rolling expander member **120** coupled to a drill string **122** is positioned at the downhole end of casing **90**. Rolling expander member **120** comprises a body **124** and two or more rollers **126** mounted on body **124**. To expand casing **90**, rollers **126** are radially extended and drill string **122** is rotated and advanced through the downhole portion of expandable casing **90**. The second expansion of the downhole portion of casing **90** creates a lap region **128** having an inner diameter **130** which is substantially equal to inner diameter **82** of lap region **80**. Following the creation of lap region **128**, rolling expander member **120** may be removed from the wellbore to the surface. Even though specific types of expander members have been described with reference to FIGS. **4** and **5**, it should be understood by to one skilled in the art that other forms of expander members may be utilized, such as expander members employing a fixed cone or expansion mandrel.

Referring now to FIG. **6**, therein is depicted monobore wellbore **68** wherein casings **74**, **90** are undergoing a coupling processes at the uphole end of casing **90** which is within lap region **80** of a casing **74** in accordance with the teachings of the present invention. In the illustrated embodiment, a crimping member **140** is positioned within the uphole end of casing **90** and lap region **80** of casing **74** to effect a hydraulic seal and mechanical connection between casings **74**, **90** by creating a metal-to-metal seal therebetween.

Crimping member **140** comprises a body **142** and multiple projection members **144** mounted on body **142**. A drill string **146** transmits fluid and rotational power to crimping member **140**. In operation, projection members **144** are hydraulically or mechanically operated to radially expand into casing **90**, thereby expanding casing **90** into casing **74**. After projection members **144** expand into casing **90**, crimping member **140** is rotated by drill string **146**. This operation creates circumferential crimps **148**, **150** in casings **74**, **90**, respectively which cooperate to form a hydraulic seal and a mechanical connection between casings **74**, **90**. The hydraulic seal prevents fluid flow between casings **74**, **90**. The mechanical connection provides the necessary strength and integrity to support the weight of multiple casings. It should be understood by those skilled in the art that although a particular coupling process has been illustrated, other coupling processes are within the teachings of the present invention including, but not limited to, downhole threading. Moreover, it should be understood by those skilled in the art that although a particular order of expansion, second expansion and coupling has been presented, the order of these operations is flexible. For example, the uphole portion of casing **74** could alternatively be coupled to lap region **80** of casing **74** prior to expanding casing **90** and forming lap region **128** of casing **90** with the second expansion.

The coupling and expanding of casing **90** completes the installation of this section of monobore wellbore **68**. It should be understood by those skilled in the art that the monobore wellbore may be extended by drilling and installing further casing sections in accordance with the teaching of the present invention.

Referring now to FIG. **7**, therein is depicted monobore wellbore **158** wherein an alternate embodiment of the present invention is employed. Casings **160**, **162** are disposed within wellbore **164** such that the uphole end of casing **162** is disposed within a lap region **166** of casing **160**. Both casings **160**, **162** are cemented within wellbore **164** by cement **168**. Casings **160**, **162** have undergone expansion and are coupled together in accordance with the teachings of the present invention. Accordingly, circumferential crimps **170**, **172** cooperate to provide a hydraulic seal and mechanical connection between casing **160** and casing **162**. Importantly, inner diameter **174** of casing **160** and inner diameter **176** of casing **162** are substantially the same to provide a monobore wellbore.

A sealing material **178** is positioned between casings **160**, **162** to provide an improved hydraulic seal and mechanical connection therebetween. Preferably sealing material **176** is an elastomeric sealant characterized by a relatively low ductility and high compressive strength. It should be appreciated that depending on the characteristics of the wellbore, the characteristics of sealing material **176** may vary. For example, sealing material **176** may be characterized by relatively high ductility and low compressive strength. As another alternative, sealing material **176** may be a hardenable resin, adhesive or material operable to be sealed by chemical bonding or thermal welding, for example.

Referring now to FIG. **8**, an exemplary monobore multilateral wellbore **190** having a junction **192** between a main wellbore **194** and lateral wellbore **196** is illustrated. Main wellbore **194** is drilled using the techniques described hereinabove in FIG. **2** or other suitable drilling techniques. A main wellbore casing **198** having an inner diameter **200** is installed in main wellbore **194** and cement **202** is disposed in an annulus **204** between main wellbore **194** and main wellbore casing **198** using the techniques described hereinabove in FIG. **3** or other suitable techniques. Main wellbore casing **198** has a lap region **206** having an inner diameter **208** that is greater than inner diameter **200** so that lap region **206** can accept additional casing for a monobore wellbore.

Using conventional techniques, a whipstock is used to guide work strings supporting a variety of tools and equipment to drill and complete lateral wellbore **196**. First, a window **210** is cut through main wellbore casing **198** by, for example, milling, drilling, chemical cutting or other suitable technique. Alternatively, window **210** of main wellbore casing **198** may be pre-milled and main wellbore casing **198** positioned in wellbore **194** such that window **210** has the correct orientation. Next a drill, similar to the drill employed in FIG. **2** or other suitable construction, is used to drill lateral wellbore **196** through window **210**. A lateral wellbore casing **212** having an outer diameter smaller than inner diameter **200** is then passed through main wellbore casing **198** and window **210** into lateral wellbore **196**. A conventional cementing tool may be used to cement an annulus **214** between lateral wellbore **196** and casing **212** with cement using a similar technique to the technique described in FIG. **3**.

Lateral wellbore casing **212** is coupled to main wellbore casing **198** at lap region **206** creating a mechanical connection and hydraulic seal between crimps **216** and crimps **218**. A sealing material, such as the elastomeric sealant discussed hereinabove, may be employed between lateral wellbore casing **212** and lap region **206**. An expander member **220** attached to coiled tubing **222** is used to expand lateral wellbore casing **212** in branch wellbore **196**. As previously described, as expander member **220** moves in a stepwise fashion, expander member **220** places a radially outward force against the wall of expandable casing **212** causing casing **212** to plastically deform. Following the expansion of casing **212**, inner diameter **224** of casing **212** is substantially the same as inner diameter **200** of casing **198**, thereby creating a monobore multilateral wellbore. After casing **198** is expanded, expander member **220** is removed.

Following the installation, coupling and expansion of lateral wellbore casing **212**, lateral wellbore **196** may be extended and additional casing may be installed in lateral wellbore **196**, by subjecting the downhole portion of lateral wellbore casing **212** to a secondary expansion to create a lap region, extending lateral wellbore **196** and installing additional casing using techniques similar to those previously discussed. The process of drilling, positioning casing, coupling, expanding and secondarily expanding to create a lap region may continue as necessary to extend lateral wellbore **196** to the desired length which creates the monobore lateral wellbore **196**.

Referring now to FIG. **9**, following the completion of lateral wellbore **196**, a window **230** is cut through lateral wellbore casing **212** at junction **192** to reestablish communication through main wellbore **194**. Window **230** allows the completion of main wellbore **194** to continue by providing a passageway for tools and casing through junction **192**. For example, as illustrated, once window **230** is cut through lateral wellbore casing **212**, additional sections of casing, such as casing **232** may be installed in main wellbore **194** in accordance with the present invention as main wellbore **194** is extended to the desired depth. Also, additional lateral wellbores can be drilled and completed from main wellbore **194** in accordance with the teachings of the present invention.

Referring now to FIG. **10**, either before or after main wellbore **194** is extended, a hydraulic seal is created between lateral wellbore casing **212** and main wellbore casing **198** to prevent fluid communication between the interior of main wellbore casing **198** and the exterior of lateral wellbore casing **212**. Lateral wellbore casing **212** is coupled to main wellbore casing **198** using a crimping member similar to crimping member **164** of FIG. **6** to form a crimped seam **234**. Crimped seam **234** seals lateral wellbore casing **212** and main wellbore casing **198** proximate to window **230**.

Referring now to FIG. **11**, an exemplary monobore wellbore **250** of adjoining wellbores is illustrated. Monobore wellbore **250** has an overlap **252** between a wellbore **254** and a wellbore **256**. Wellbores **254**, **256** are drilled using the techniques described hereinabove in FIG. **2** or other suitable drilling techniques. A wellbore casing **258** having an inner diameter **260** is installed in wellbore **254** and cement **262** is disposed in an annulus **264** between wellbore **254** and wellbore casing **258** using the techniques described hereinabove in FIG. **3** or other suitable techniques. Wellbore casing **258** has a lap region **266** having an inner diameter **268** that is greater than inner diameter **260** so that lap region **266** can accept casing from wellbore **256** to form a monobore wellbore.

Similarly, a wellbore casing **270** having an inner diameter **272**, after expansion, is installed in wellbore **256** and cement **274** is disposed in an annulus **276** between wellbore **256** and wellbore casing **270**. As illustrated, wellbore casing **270** includes an unexpanded portion **278** having an inner diameter **280** and a guide portion **282** for guiding wellbore casing **270** into lap region **266** of wellbore casing **258** to form a monbore wellbore.

As illustrated, after wellbore casing **270** is guided into wellbore casing **258** at lap region **266**, expander member **282** attached to coiled tubing **284** is used to expand wellbore casing **270** into wellbore casing **258**. As previously described, as expander member **282** moves in a stepwise fashion, expander member **282** places a radially outward force against the wall of expandable casing **270** causing casing **270** to plastically deform. Following the expansion of casing **270**, inner diameters **272**, **280** of casing **270** are substantially the same as inner diameter **260** of casing **258**, thereby creating a monobore wellbore. After casing **270** is expanded, expander member **282** is removed.

Referring now to FIG. **12**, monobore wellbore casing **258** is coupled to monobore wellbore casing **270** creating a mechanical connection and a hydraulic seal therebetween. Wellbore casing **270** is coupled to wellbore casing **258** using a crimping member similar to crimping member **164** of FIG. **6** to form connection **290**, thereby creating a monobore wellbore of adjoining wellbores.

Referring now to FIG. **13**, an exemplary monobore wellbore **300** of adjoining wellbores having a junction **302** is illustrated. As used herein the term adjoining wellbores refers to making a downhole connection between two or more wellbores that extend to the surface. In the illustrated embodiment, a wellbore **304** has a substantially vertical portion **306** and a substantially horizontal portion **308** that are drilled using the techniques described above or other suitable drilling techniques. A wellbore casing **310** having an inner diameter **312** is installed in wellbore **304** and cement **314** is disposed in an annulus **316** between wellbore **304** and wellbore casing **310** using the techniques described above or other suitable techniques. Wellbore casing **310** has a lap region **318** having an inner diameter **320** that is greater than inner diameter **312**. Lap region **320** can accept additional casing strings therein such as wellbore casing **322** that is coupled to wellbore casing **310** using the techniques of the present invention described above at crimped connection **324** which provides a mechanical connection and a hydraulic seal. Following the expansion of casing **322**, inner diameter **326** of casing **322** is substantially the same as inner diameter **312** of casing **310**, thereby creating a monobore wellbore in the horizontal portion **308** of wellbore **304**.

Wellbore casing **310** also has a window **328** formed through a sidewall portion thereof that receives a wellbore casing **330** from an adjacent wellbore **332** such that wellbore casing **310** of wellbore **304** adjoins wellbore casing **330** of wellbore **332**. Wellbore casing **330** is cemented within wellbore **332** and is expanded using the techniques described above or other suitable techniques such that inner diameter **334** of casing **330** is substantially the same as inner diameter **312** of casing **310**. Wellbore casing **330** is coupled to wellbore casing **310** at lap region **318** creating a mechanical connection and hydraulic seal at crimped connection **336** using the techniques of the present invention described above. Thereafter, crimped seam **338** is formed which seals wellbore casing **310** and wellbore casing **330** proximate to window **328** to complete junction **302**, thereby creating the monobore wellbore of adjoining wellbores wherein adjoining main wellbores are coupled together.

Referring now to FIG. **14**, an exemplary monobore wellbore **350** of adjoining wellbores is illustrated. In the illustrated embodiment, a wellbore **352** has a substantially vertical portion **354** and a substantially horizontal portion **356** that are drilled using the techniques described above or other suitable drilling techniques. A wellbore casing **358** having an inner diameter **360** is installed in wellbore **352** and cement **362** is disposed in the annulus therebetween using the techniques described above or other suitable techniques. Wellbore casing **358** has a lap region **364** having an inner diameter that is greater than inner diameter **360**.

A wellbore **366** has a main wellbore **368** and a branch wellbore **370**. Main wellbore **368** has a substantially vertical portion **372** and a substantially horizontal portion **374** that are drilled using the techniques described above or other suitable drilling techniques. A main wellbore casing **376** having an inner diameter **378** that is substantially the same as inner diameter **360** of casing **358** is installed and cemented in main wellbore **368** using the techniques described above or other suitable techniques. Main wellbore casing **376** has a lap region **380** having an inner diameter that is greater than inner diameter **378**. Branch wellbore casing **382** extends into branch wellbore **370** from lap region **380**. Branch wellbore casing **382** is expanded and cemented within branch wellbore **370** using the techniques described above or other suitable techniques such that inner diameter **384** of branch wellbore casing **382** is substantially the same as inner diameter **360** of casing **358**. Branch wellbore casing **382** is coupled to main wellbore casing **376** at lap region **380** creating a mechanical connection and hydraulic seal at crimped connection **386** using the techniques of the present invention described above. Thereafter, crimped seam **388** is formed which seals main wellbore casing **376** and branch wellbore casing **382** proximate to window **390** to complete junction **392**.

A main wellbore casing extension **394** extends from lap region **380** of main wellbore casing **376** to lap region **364** of wellbore casing **358**. Following expansion, inner diameter **396** of main wellbore casing extension **394** is substantially the same as inner diameter **360** of casing **358**. Main wellbore casing extension **394** is coupled to main wellbore casing **376** at lap region **380** creating a mechanical connection and hydraulic seal at crimped connection **398** using the techniques described above. Similarly, main wellbore casing extension **394** is coupled to wellbore casing **358** at lap region **364** creating a mechanical connection and hydraulic seal at crimped connection **399** using the techniques described above, thereby creating the monobore wellbore of adjoining wellbores wherein adjoining main wellbores are coupled together.

Referring now to FIG. **15**, another exemplary monobore wellbore **400** of adjoining wellbores is illustrated. In the illustrated embodiment, wellbore **402** has a main wellbore **404** and a branch wellbore **406** that are drilled using the techniques described above or other suitable drilling techniques. A main wellbore casing **408** having an inner diameter **410** is installed and cemented in main wellbore **404** using the techniques described above or other suitable techniques. Main wellbore casing **408** has a lap region **412** having an inner diameter that is greater than inner diameter **410**. A main wellbore casing extension **414** extends from lap region **412** of main wellbore casing **408**. Following expansion, inner diameter **416** of main wellbore casing extension **414** is substantially the same as inner diameter **410** of casing **408**. Main wellbore casing extension **414** is coupled to main wellbore casing **408** at lap region **412** creating a mechanical connection and hydraulic seal at crimped connection **418** using the techniques of the present invention described above.

A branch wellbore casing **420** extends into branch wellbore **406** from lap region **412**. Branch wellbore casing **420** is expanded and cemented within branch wellbore **406** using the techniques described above or other suitable techniques such that inner diameter **422** of branch wellbore casing **420** is substantially the same as inner diameter **410** of casing **408**. Branch wellbore casing **420** is coupled to main wellbore casing **408** at lap region **412** creating a mechanical connection and hydraulic seal at crimped connection **424** using the techniques of the present invention described above. Thereafter, crimped seam **426** is formed which seals main wellbore casing **408** and branch wellbore casing **420** proximate to window **428** to complete junction **430**.

An adjacent wellbore **432** has a substantially vertical portion **434** and a substantially horizontal portion **436** that are drilled using the techniques described above or other suitable drilling techniques. A wellbore casing **438** having an inner diameter **440** that is substantially the same as inner diameter **410** of casing **408** is installed in wellbore **432** and cement **442** is disposed in the annulus therebetween using the techniques described above or other suitable techniques. Branch wellbore casing **420** has a lap region **444** having an inner diameter that is greater than inner diameter **410**. Wellbore casing **438** is coupled to branch wellbore casing **420** at lap region **444** creating a mechanical connection and hydraulic seal at crimped connection **446** using the techniques of the present invention described above, thereby creating the monobore wellbore of adjoining wellbores wherein a branch wellbore is coupled to an adjoining main wellbore.

Referring now to FIG. **16**, another exemplary monobore wellbore **450** of adjoining wellbores is illustrated. In the illustrated embodiment, wellbore **452** has a main wellbore **454** and a branch wellbore **456** that are drilled using the techniques described above or other suitable drilling techniques. A main wellbore casing **458** having an inner diameter **460** is installed and cemented in main wellbore **454** using the techniques described above or other suitable techniques. Main wellbore casing **458** has a lap region **462** having an inner diameter that is greater than inner diameter **460**. A main wellbore casing extension **464** extends from lap region **462** of main wellbore casing **458**. Following expansion, inner diameter **466** of main wellbore casing extension **464** is substantially the same as inner diameter **460** of casing **458**. Main wellbore casing extension **464** is coupled to main wellbore casing **458** at lap region **462** creating a mechanical connection and hydraulic seal at crimped connection **468** using the techniques of the present invention described above.

A branch wellbore casing **470** extends into branch wellbore **456** from lap region **462**. Branch wellbore casing **470** is expanded and cemented within branch wellbore **456** using the techniques described above or other suitable techniques such that inner diameter **472** of branch wellbore casing **470** is substantially the same as inner diameter **460** of casing **458**. Branch wellbore casing **470** is coupled to main wellbore casing **458** at lap region **462** creating a mechanical connection and hydraulic seal at crimped connection **474** using the techniques of the present invention described above. Thereafter, crimped seam **476** is formed which seals main wellbore casing **458** and branch wellbore casing **470** proximate to window **478** to complete junction **480**.

An adjacent wellbore **482** has a main wellbore **484** and a branch wellbore **486** that are drilled using the techniques described above or other suitable drilling techniques. A main wellbore casing **488** having an inner diameter **490** is installed and cemented in main wellbore **484** using the techniques described above or other suitable techniques. Main wellbore casing **488** has a lap region **492** having an inner diameter that is greater than inner diameter **490**. A main wellbore casing extension **494** extends from lap region **492** of main wellbore casing **488**. Following expansion, inner diameter **496** of main wellbore casing extension **494** is substantially the same as inner diameter **460** of casing **458**. Main wellbore casing extension **494** is coupled to main wellbore casing **488** at lap region **492** creating a mechanical connection and hydraulic seal at crimped connection **498** using the techniques of the present invention described above.

A branch wellbore casing **500** extends into branch wellbore **486** from lap region **492**. Branch wellbore casing **500** is expanded and cemented within branch wellbore **486** using the techniques described above or other suitable techniques such that inner diameter **502** of branch wellbore casing **500** is substantially the same as inner diameter **460** of casing **458**. Branch wellbore casing **500** is coupled to main wellbore casing **488** at lap region **492** creating a mechanical connection and hydraulic seal at crimped connection **504** using the techniques of the present invention described above. Thereafter, crimped seam **506** is formed which seals main wellbore casing **488** and branch wellbore casing **500** proximate to window **508** to complete junction **510**. Branch wellbore casing **470** has a lap region **512** having an inner diameter that is greater than inner diameter **460**. Branch wellbore casing **500** is coupled to branch wellbore casing **470** at lap region **512** creating a mechanical connection and hydraulic seal at crimped connection **514** using the techniques of the present invention described above, thereby creating the monobore wellbore of adjoining wellbores wherein adjoining branch wellbores are coupled together.

While this invention has been described with reference to illustrative embodiments, this description is not intended to be construed in a limiting sense. Various modifications and combinations of the illustrative embodiments as well as other embodiments of the invention, will be apparent to persons skilled in the art upon reference to the description. It is, therefore, intended that the appended claims encompass any such modifications or embodiments.

What is claimed is:

1. A monobore system of adjoining wellbores comprising:

a first casing positioned within a first wellbore extending from the surface, the first casing having a first inner diameter and a lap region; and

a second casing positioned within a second wellbore extending from the surface that adjoins the first wellbore such that a downhole end of the second casing is positioned within the lap region of the first casing, the second casing having a second inner diameter that is substantially the same as the first inner diameter, the downhole end of the second casing being coupled to the lap region of the first casing when the first casing is positioned within the first wellbore and the second casing is positioned within the second wellbore.

2. The monobore system as recited in claim **1** wherein the downhole end of the second casing forms a mechanical connection and a hydraulic seal with the lap region of the first casing.

3. The monobore system as recited in claim **1** wherein the downhole end of the second casing and lap region of the first casing are physically deformed.

4. The monobore system as recited in claim **1** wherein the downhole end of the second casing and lap region of the first casing are physically deformed by a plastic deformation process.

5. The monobore system as recited in claim **1** wherein the second casing intersects the first casing through a window in the first casing forming a junction therewith.

6. The monobore system as recited in claim **1** wherein the first casing comprises a main wellbore casing of a multilateral wellbore.

7. The monobore system as recited in claim **1** wherein the first casing comprises a branch wellbore casing of a multilateral wellbore.

8. The monobore system as recited in claim **1** wherein the second casing comprises a main wellbore casing of a multilateral wellbore.

9. The monobore system as recited in claim **1** wherein the second casing comprises a branch wellbore casing of a multilateral wellbore.

10. The monobore system as recited in claim **1** wherein the first and second casings comprise branch wellbore casings of multilateral wellbores.

11. The monobore system as recited in claim **1** wherein the first and second casings comprise main wellbore casings of multilateral wellbores.

12. The monobore system as recited in claim **1** wherein the first casing is a main wellbore casing and the second casing comprises a branch wellbore casing of a multilateral wellbore.

13. The monobore system as recited in claim **1** wherein the first casing comprises a branch wellbore casing and the second casing is a main wellbore casing of a multilateral wellbore.

14. A method of forming a connection between adjoining wellbores comprising the steps of:

installing a first casing within a first wellbore extending from the surface, the first casing having a first inner diameter and a lap region;

installing a second casing within a second wellbore extending from the surface that adjoins the first wellbore such that a downhole end of the second casing is positioned within the lap region of the first casing, the second casing having a second inner diameter that is substantially the same as the first inner diameter; and

coupling the downhole end of the second casing to the lap region of the first casing downhole.

15. The method as recited in claim **14** wherein the coupling step further comprises forming a mechanical connection and a hydraulic seal between the second casing and the lap region of the first casing.

16. The method as recited in claim **14** wherein the coupling step further comprises physically deforming the downhole end of the second casing and lap region of the first casing.

17. The method as recited in claim **14** wherein the coupling step further comprises plastically deforming the downhole end of the second casing and lap region of the first casing.

18. The method as recited in claim **14** wherein the installing a second casing step further comprises intersecting the second casing with the first casing through a window in the first casing forming a junction therewith.

19. The method as recited in claim **14** wherein the installing a first casing step further comprises installing a main wellbore casing in a multilateral wellbore.

20. The method as recited in claim **14** wherein the installing a first casing step further comprises installing a branch wellbore casing in a multilateral wellbore.

21. The method as recited in claim **14** wherein the installing a second casing step further comprises installing a main wellbore casing of a multilateral wellbore.

22. The method as recited in claim **14** wherein the installing a second casing step further comprises installing a branch wellbore casing in a multilateral wellbore.

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